SD
11
.A
A42
no. 257

Forest
Service

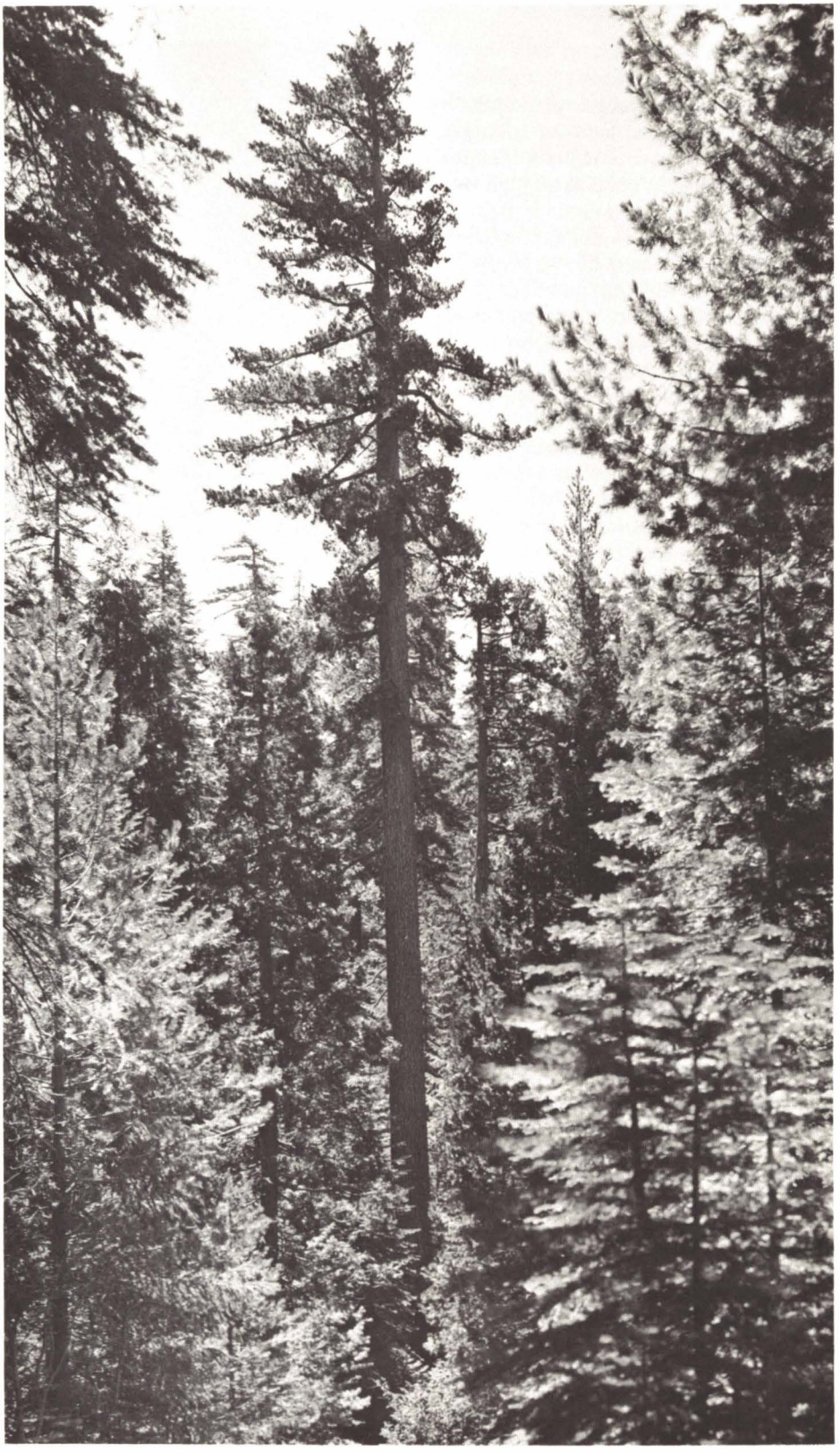
United States
Department of
Agriculture

FS-257

Sugar Pine

An American Wood

Sugar pine, one of the most valuable softwood trees, is widely distributed in montane regions of the far Western United States in mixed-conifer forests. The largest of all pines, the species is prized for its soft, light, even-grained, and easily worked wood in products that require high dimensional stability and large, clear pieces—from all kinds of millwork to foundry patterns and organ pipes. Present growing stock volume is slightly greater than 1 percent of all western conifers. Removals in recent years have been nearly double the net annual growth.



F-309501

Sugar Pine

(*Pinus lambertiana* Dougl.)

Bohun B. Kinloch[1]

Distribution

The native range of sugar pine spans nearly 15 degrees of latitude, from just south of the Columbia River in Oregon to a small isolated population high in the Sierra San Pedro Martir in Baja California (fig. 1). A montane species, it is distributed almost continuously throughout the Klamath and Siskiyou Mountains of northern California and southern Oregon, and on the western slopes of the Cascade Range and Sierra Nevada. Smaller and more disjunct populations occur in the Coast Ranges of southern California and east of the Cascade and Sierra Nevada crests.

Sugar pine ranges from near sea level in the northern Coast Ranges to nearly 10,000 feet in the San Bernardino Mountains. Factors limiting survival are drought at lower elevations and cold at higher elevations. Consequently, elevational limits increase with decreasing latitude, following patterns of temperature and precipitation: at equivalent latitudes, temperature decreases and precipitation increases with elevation, and at equivalent elevations, temperature increases and precipitation and humidity decrease from north to south. Typical elevational ranges are from 1,100 to 5,400 feet in the Cascade Range, 2,000 to 7,500 feet in the Sierra Nevada, and 4,500 to 10,500 in the Transverse Ranges.

Figure 1—Natural range of sugar pine (*Pinus lambertiana* Dougl.). F-532735

[1]Geneticist, U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

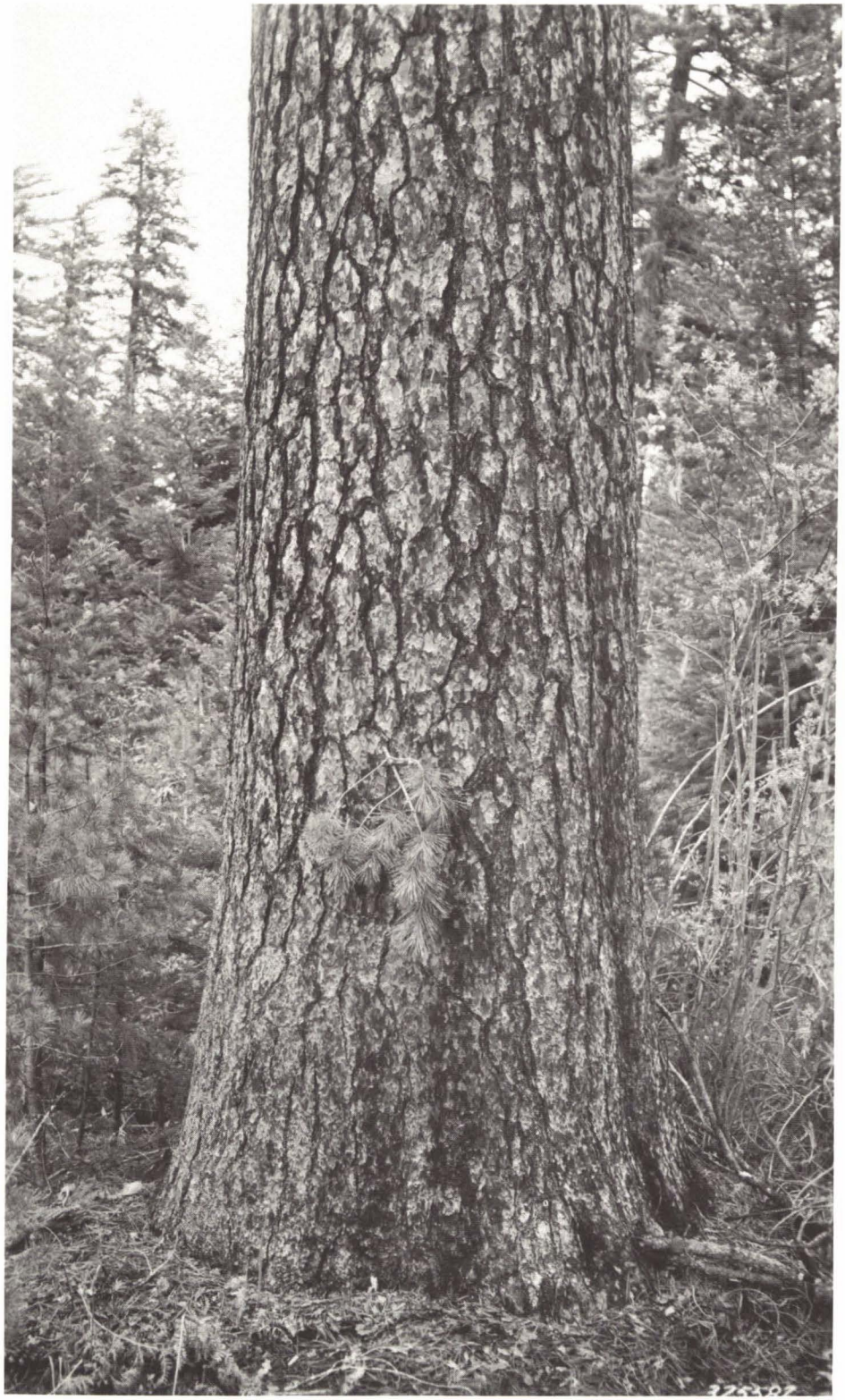


Figure 2—Bark of mature sugar pine. F-325582

Sugar pine reaches its optimal growth and highest density at middle elevations in the Sierra Nevada, between Tulare and El Dorado Counties, Calif., where annual rainfall is 40 inches or more. Rarely forming pure stands of more than an acre, it grows singly or in small groups. It is a major component in the Sierra Nevada Mixed-Conifer Type, generally comprising 5 to 25 percent of the stocking (but sometimes up to 60 percent), and a minor component in 10 other forest types. Its principal coniferous associates include ponderosa pine, white fir, Douglas-fir, incense-cedar, and giant sequoia. Other occasional associates are Jeffrey pine and California red fir at higher elevations, and Coulter pine, knobcone pine, and bigcone Douglas-fir lower down. The main broadleaf species that grow with sugar pine are California black oak, canyon live oak, Pacific madrone, and tanoak.

Sugar pine grows on a wide variety of soils derived from rocks of volcanic, granitic, and sedimentary origin, and their metamorphic equivalents, but grows best on well-drained loams and sandy loams. It is found on all aspects in the northern and central part of its range, but is often confined to level terrain or cooler north-facing slopes in the south.

Description and Growth

The massive dimensions of mature sugar pine—its clear straight bole, and huge asymmetrical limbs hung with long, cylindrical cones at their tips—inspired descriptions by early naturalists that were more poetic than scientific. John Muir considered that ". . .no two are alike, even to the most inattentive observers; and, notwithstanding they are even tossing out their immense arms in what might seem most extravagant gestures, there is a majesty and repose about them. . .," which, in Willis Jepson's words ". . .more than any other tree gives beauty and distinction to the Sierran forest." David Douglas, the Scot-

tish botanist who first discovered the species, called it "the most princely of the genus," a designation earned by the first tree he measured and described in his diary. Douglas recorded that it was ". . .three feet from the ground, 57 feet 9 inches in circumference; 134 feet from the ground, 17 feet 5 inches; extreme length 215 feet."

Trees of this size no longer exist. They were removed during the logging of the best sugar pine sites a century or more ago. Nevertheless, sugar pine remains the tallest and largest tree of its genus and of all its associates except the giant sequoia. The current champion measures 10.2 feet in diameter at breast height (4.5 ft) and 216 feet high, but trees up to 250 feet tall have been reported.

Sugar pines often reach 300 years of age, and occasionally live more than 500 years. Young crowns are symmetrical and conical, but assume eccentric and even bizarre shapes with maturity. Often one or two branches, extending at varied angles as far as 40 feet from the trunk, will dominate over the rest, lending individually to each tree and distinguishing it at a distance from companion species.

Needles, in fascicles of five, are 2.75 to 4 inches long, and enclosed by a thin sheath at the base, which is shed after 1 year. Needles are retained at least 2, and occasionally, several years longer before they are shed. They are green to deep blue green, depending on the amount of surface wax present. Newly emerging twigs are pale green to yellow green with a slightly sticky pubescence. Bark on young stems and branch terminals of older trees is thin, smooth, and silver gray. It becomes thickly furrowed with rich cinnamon-brown plates tinged with a purplish or reddish cast on veteran trees (fig. 2).

Prized for their ornamental beauty, the cones of sugar pine are among the largest of any conifer (fig. 3). Specimens up to 26 inches long can be

Figure 3—Sugar pine cones. **F-531871**

found, although the average is only about 12 inches. First-year conelets are erect and only 1 to 2 inches long when they are ready to receive pollen in June or July. By the following summer, the rapidly elongating cones becomes pendulous on stalks about 6 inches long at the tips of branches, and easily distinguish sugar pine from its neighbors. Ripening is usually complete by the end of August, and seeds shed by October.

Seeds are brown to nearly black, winged, and large (0.5 to 0.63 inch long). They are eagerly sought by small rodents and birds, which aid in their dispersal. Seeds were a delicacy to Indians, who ate them as nuts or ground them into a paste called lopa for special feasts.

Early growth of sugar pine is slow compared with that of ponderosa pine, but growth rates accelerate with age and are sustained for longer periods of time than those of associated species, except possibly giant sequoia. Following heavy thinning, the basal area increment of sugar pine is often double that of other conifers. Consequently, sugar pines are the largest trees in both height and diameter in old-growth stands.

A fungal disease that seriously limits both natural and artificial regeneration of sugar pine is white pine blister rust, which was inadvertently introduced to western North America around the turn of the century. This disease attacks all native white pines, but sugar pine is one of the most susceptible species. Seedlings and young saplings almost inevitably die within a few years after becoming infected. To complete its life cycle, the causal fungus (*Cronartium ribicola* Fisch.), requires an alternate host in an unrelated genus (*Ribes*), which includes many native species of currants and gooseberries. Early attempts to control the disease by eradicating these well-adapted and persistent shrubs from the forest were largely unsuccessful, and current emphasis has shifted to selection and breeding of sugar pines with natural, genetically controlled resistance.

Common Name

The resin that exudes from wounded bark gives sugar pine its only common name. On drying, the resin becomes white and tastes sweet. "The sugar," John Muir said, "is to my taste the best of sweets—better than maple sugar. It exudes . . . in the shape of irregular, crisp, candy-like kernels . . . Indians are fond of it, but on account of its laxative properties, only small quantities may be eaten." The taste derives not from a true sugar, but a sugar-alcohol called pinitol (monomethyl D-inositol).

Related Commercial Species

Sugar pine belongs to the white, or soft pines, members of a sub-genus differentiated from the yellow, or hard, pines by relatively light, soft, white wood and needles in bundles of five. Only two other white pines of commercial importance grow in North America: western white pine (*P. monticola* Dougl.), which is an occasional associate of sugar pine, and eastern white pine (*P. strobus* L.). Wood of the three species is very similar and used interchangeably.

Supply

Growing stock of sugar pine was estimated at 4.1 billion cubic feet (20.4 billion board feet) in 1977, a decline of 5 percent since 1970. Over 80 percent of this volume is in California, mostly on the western slopes of the Sierra Nevada. The next highest concentration is in the Klamath and Siskiyou Mountains and Cascade Range of southwestern Oregon and northwestern California. Over half of the growing stock volume is in trees over 29 inches in diameter at breast height. Sugar pine growing stock volume amounts to 7.3 percent of all coniferous species in California and 1.3 percent of all western conifers.

Production

Average annual production of sugar pine lumber from 1970 to 1979 was 218 million board feet (range: 173 to 258 million board feet), representing approximately 2 percent of softwood production in the Western United States. Total harvest in California was 84.3 million cubic feet in 1976, almost double the net annual growth.

Prices fluctuate widely from year to year, but from 1976 to 1980 the average value of sugar pine was more than double the average for all other softwoods in California and second only to Douglas-fir and Port-Orford-cedar in Oregon.

Characteristics and Properties

Sapwood of sugar pine is creamy white to pale yellowish white, and often discolored by blue-stain fungi. Heartwood is buff or light brown, sometimes tinged with red (through never as deeply red as eastern or western white pines). Growth rings are distinct, consisting mainly of early wood, with a gradual transition to a narrow band of darker, denser late wood. Numerous resin canals occupy the central and outer portions of growth rings. In physical properties, the wood resembles that of eastern white and western white pines. It is light weight, weighting about 25 pounds per cubic foot at 12 percent moisture content with a specific gravity of 0.34, based on green volume and oven dry weight. It is moderately soft, straight- and even-grained, and of fairly even texture, making it easily worked with tools. Shrinkage is low, giving it high dimensional stability, and it seasons without warping or checking. The wood is moderately low in strength, shock resistance, and stiffness. It has no taste and only a faint odor.

Principal Uses

Early uses of sugar pine were more prodigal than the high prices of recent

decades would allow, and much of this valuable resource was squandered. From the earliest years of settlement in the Sierra Nevada foothills, the large volume and ease of cutting and working made sugar pine the preferred lumber tree. To serve the sudden demand created by the gold rush, sawmills were set up to manufacture lumber for every conceivable use of the day including: flumes, sluice boxes, bridges, houses, barns, fences, and mine props. Hand-hewn shakes and shingles were also made of sugar pine, a particularly wasteful use for such wood. Often, over half of a tree that would have yielded from 10,000 to 20,000 board feet was left to rot in the woods. Perhaps the most wanton use, however, was for fencing livestock. Whole trees were cut and dropped end to end to make corrals for sheep or fences for cattle.

Almost all of the present cut of sugar pine is manufactured into lumber and lumber products. Because of its light weight, color, and good nailing properties, it is a preferred wood for boxes and crates. Its lack of taste and odor make sugar pine an ideal container for storing fruits, grains, spices, coffee, tea, and pharmaceuticals. The availability of clear wood in large dimensions, its ease of cutting in any direction, and its ability to take and hold paint make sugar pine especially suitable for millwork such as doors, sashes, trim, siding, and panels. Lower grades are used in construction for sheathing, subflooring, roofing, and the like. High dimensional stability puts sugar pine wood in exceptionally high demand for foundry patterns, which have exacting requirements for minimal shrinkage and swelling, and must be free from twisting and warping. Other special uses include piano keys and organ pipes, which demand wood of especially straight, even grain.

References

Brown, H. P.; Panshin, A. J.; Forsaith, C. C. Textbook of wood technology. New York: McGraw Hill; 1949. 652 p.

Fowells, H. A.; Schubert, G. H. Sugar pine. In: Fowells, H. A., ed. Silvics of forest trees of the United States. Agric. Handb. 271. Washington, DC: U.S. Department of Agriculture; 1965: 464–407.

Peattie, D. C. A natural history of western trees. New York: Bonanza Books; 1950. 751 p.

U.S. Department of Agriculture, Forest Service. Forest statistics of the U.S., 1977 (review draft). Washington, DC: U.S. Department of Agriculture, Forest Service; 1978. 133 p.

U.S. Department of Agriculture, Forest Service. The outlook for timber in the United States. Forest Resour. Rep. 20. Washington, DC: U.S. Department of Agriculture, Forest Service; 1974. 374 p.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. Wood handbook: wood as an engineering material. Agric. Handb. 72. Rev. ed. Washington, DC: U.S. Department of Agriculture; 1974. 428 p.

February 1984

This publication supersedes an unnumbered American Wood leaflet, Sugar Pine, last revised May 1960.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1984 O - 415-844 (Item 5)